air lying over each of the zones, and thus make available numerical values from which we can readily compute the net advective exchange of air across the boundaries of each zone between midwinter and midsummer. Table 7-B, from Spitaler also, shows the (equivalent) masses of air lying over the various zones, the data being expressed in cubic kilometers of mercury. To convert these data to units of mass, the relation: 1 km³ mercury $=13.6\times10^{12}$ kg mass, may be used.

TABLE 7.—*A. Mean actual pressures (mm Hg) averaged over 10° zones. B. Mean masses of air* [1] *(expressed in km³ mercury) lying over 10° zones*

Latitudinal limits of zones	A		B		
	January	July	January	July	Difference, January–July
80° to 70° N	726.08	729.05	8,343.0	8,377.0	−34.0
70° to 60° N	729.18	729.56	13,681.3	13,688.4	−7.1
60° to 50° N	734.63	735.03	18,707.0	18,717.1	−10.1
50° to 40° N	729.54	730.28	22,901.6	22,925.3	−23.7
40° to 30° N	715.42	715.20	26,017.1	26,009.4	7.7
30° to 20° N	741.37	737.55	29,829.3	29,675.7	153.6
20° to 10° N	750.53	747.93	32,184.6	32,073.1	111.5
10° to 0° N	748.72	748.84	33,113.1	33,118.5	−5.4
0° to 10° S	744.53	746.55	32,927.7	33,016.9	−89.2
10° to 20° S	743.18	746.90	31,870.0	32,028.6	−158.6
20° to 30° S	744.72	748.73	29,964.0	30,126.0	−162.0
30° to 40° S	754.03	755.20	27,421.3	27,463.8	−42.5
40° to 50° S	756.82	755.22	23,757.9	23,707.8	50.1

[1] Table 7-B is obtained by converting the values given in Table 7-A to km of Hg and multiplying the results thus obtained by the corresponding areas of the 10° zones expressed in km². The areas of the 10° zones were determined on the basis of the assumption that the earth is a sphere of radius 6,366.7 km. Table 7-B thus does not represent precisely the mean actual masses of air lying over the zones, divided by the density of mercury, i.e., the volumes of mercury whose masses are equal to the actual masses of air lying over the zones, because the joint effect of the variations of gravity, latitudinally and vertically, has been omitted in computing the data. Thus analytically, table 7-B is given by the expression $A\times B_o$, whereas the volume of mercury whose mass is equal to the mass of air lying over the zone is given by the expression $A\times B_o\times g_s/g_m$, where A=area of zone (km²); B_o=mean height (km) of mercury in the barometer at the surface of the zone, when reduced to standard temperature (0° C.) and standard gravity; g_s=standard gravity=980.665 cm/sec²; and

$$\frac{1}{g_m}\equiv\frac{-\int_{B_o}^{0}\frac{dB}{g}}{B_o},$$

in which g= value of gravity in the free air corresponding to the height above the surface of the zone where the barometer (reduced to standard conditions of temperature and gravity) is B in general, conditions being assumed average for the zone. Calculation shows g_m to correspond to the value of gravity at about 7,500 m elevation above sea level. Hence for the zone 0°–10°, $g_s/g_m=1.0050$, and for the zone 70°–80°, $g_s/g_m=1.0001$, approximately. Also, if the earth had been considered as a spheroid instead of a sphere, slightly different results would have been obtained for the areas of the zones. See, for example, p. 142, Smithsonian Geographical Tables, Smithsonian Institution, Washington, D.C., 1906.

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HEAVY RAINFALL IN GEORGIA

By GEORGE W. MINDLING

[Weather Bureau, Atlanta, Ga., Sept. 15, 1933]

The St. George record.—Georgia lies within a region that is remarkable for its excessive rains. The greatest 24-hour rainfall on record in the State is 18 inches at St. George on August 28–29, 1911. This record when made had been equaled once in Texas and exceeded once in Louisiana. At the present it has been surpassed three times in Texas, twice in Louisiana, and once each in Alabama, Florida, and North Carolina. The greatest of these was 23.22 inches at New Smyrna, Fla., October 9–10, 1924.

The St. George record is more than double that in connection with any outstanding flood of the northern part of the United States, including that of Johnstown, Pa., in May 1889; the Great Miami River flood of March 1913 at Dayton, Ohio; and the Vermont flood of November 1927.

Greatest 24-hour rainfall, by States.—Rainfall of 10 inches or more within 24 hours has never been measured in several of the Northern States, and, in some of the Rocky Mountain States not even as much as 5 inches.

Twenty-four-hour rainfalls of 15 inches or more are unknown in this country except in some of the States adjacent to the coast from North Carolina to Texas and in California. Complete data are not available for South Carolina and Mississippi, but for the other States in the regions indicated the maximum amounts for 24 hours are:

State	Amount	Place	Date
	Inches		
North Carolina	22.22	Altapass	July 15–16, 1916.
Georgia	18.00	St. George	Aug. 28–29, 1911.
Florida	23.22	New Smyrna	Oct. 9–10, 1924.
Alabama	20.00	Elba	Mar. 14–15, 1929.
Louisiana	21.40	Alexandria	June 15–16, 1886.
Texas	23.11	Taylor	Sept. 9–10, 1921.
California	16.81	Squirrel Inn	Jan. 17, 1916.

South Carolina is known to have had a record of 13.25 inches in July 1916, and Mississippi one of 12.35 inches in the same month and year.

Ten-inch rains in Georgia.—These extraordinary rainfalls usually have been directly associated with storms of tropical origin. All known instances of 24-hour rains of 10 inches or more in Georgia, except one at Blakely in March 1929, resulted from West Indian hurricanes that passed over the southern part of the State or close to the coast.

Following is a complete list of the 24-hour rains of 10 inches or more that have been recorded in Georgia:

Amount (inches)	Place	Date
18	St. George	Aug. 28–29, 1911.
10.08	Savannah	Sept. 15–16, 1924.
11.44	do	Sept. 17–18, 1928.
10.40	Savannah (2)	Do.
10.88	Blakely	Mar. 15, 1929.
15	Glennville	Sept. 27, 1929.
12.75	Brooklet	Do.
10.45	Meldrim	Sept. 5–6, 1933.

Ten-inch rains in other States.—Lists of such rains within 24 hours have been obtained from the climatological centers of the various sections and are partly summarized in the following table, the records in the respective States beginning with the year indicated and extending through 1932.

Section	Year record began	Number of months with 10 inches or more	Most local instances 10 inches or more in one month	Greatest 24-hour rainfall on record
				Inches
Alabama	1884	14	6	20.00
California	1897	9	5	16.81
Florida	1892	24		23.22
Georgia	1892	5	2	18.00
Iowa	1873	6	4	[1] 16.00
Louisiana	1891	16	3	21.40
Maryland-Delaware	1868	3	1	14.75
North Carolina	1887	3	7	22.22
Tennessee	1884	3	1	[1] 14.98
Texas	1891	35	5	23.11

[1] Unofficial, but well authenticated measurements.

When allowance is made for length of record and the number of stations in the different sections, it is evident that Georgia is surpassed as to heavy rains only by Alabama, Florida, Louisiana, and Texas.

Records of 10 inches or more have been made in only 2 different months each in Arkansas, Missouri, Nebraska, and Wisconsin, with maximum amounts ranging from 11.25 to 12.25 inches. A single instance of 10 inches or more has been recorded in each of the following States with a maximum of 12.18 inches in Oregon: Illinois, Indiana, Kansas, Minnesota, Montana, New York, Oklahoma, Oregon, Rhode Island, and Washington.

Lesser heavy rains.—Georgia's prominence as to heavy rains does not rest on a few cases of enormous downpours of 10 to 18 inches, but is supported also by the frequent occurrence of 24-hour rains of 5 inches or more, 3 inches or more, 1 inch or more, and an imposing array of instances of prolonged heavy rains extending over several days.

Greatest 24-hour rainfalls at 52 stations.—The greatest 24-hour rainfalls have been determined by months and years for 52 stations having the most satisfactory long records in Georgia. Only 3 of these stations have never had as much as 5 inches in 24 hours; 23 have had over 7 inches; 15, over 8 inches; and 5, over 10 inches.

The maximum amounts on record show a strong tendency to occur in either the late summer or early spring. The following table shows the number of stations having their maximum amounts in each of the respective months.

January	1	July	2
February	4	August	9
March	10	September	15
April	5	October	4
May	1	November	0
June	0	December	1

Monthly charts of the greatest 24-hour rainfall on record for the various stations show only small irregular areas with as much as 5 inches in the cooler season, November to February, inclusive, when the tendency is for the heavier rains to occur in the interior of the State.

In March more than one third of Georgia has had 5 inches or more within 24 hours, chiefly in the western and northern sections. There is an evident letdown in excessive rains during April and May followed by a slight pickup in June and a very marked spread of rainfalls of this intensity in August and September, especially in the southern and eastern parts of the State, which are most strongly affected by storms of tropical origin.

October has fewer heavy rains than September, and the 5-inch area for this month is limited chiefly to the upper Savannah River watershed.

Greatest 24-hour rainfall in Georgia, by months.—The greatest 24-hour rainfall in the State has been compiled for each month through a period of 38 years, together with the number of local instances of 5 inches or more. In this period 104 months had 5 inches or more within 24 hours somewhere in the State, an average of little less than 3 such months to the year. The number of instances of such rainfall at different stations (including any instances at the same station in different months) was 286.

The following is a list of the months in which 10 or more stations recorded 5 inches or more of rain within 24 hours.

Month:	Number of stations
September 1901	11
September 1903	10
July 1916	13
August 1928	10
March 1929	10
September 1929	12
October 1929	10
September 1933	10

The months of occurrence of 24-hour rains of 5 inches or more somewhere in the State were as shown in the following table for this 38-year period. Note the prominence of the July to October season, the sharp falling off in November, the winter pickup culminating in March, and the secondary letdown in April and May.

Occurrence of 5 inches or more in 24 hours somewhere in the State

Month:

Month	Different years	Month	Different years
January	3	July	13
February	8	August	13
March	14	September	18
April	7	October	10
May	4	November	2
June	6	December	6

The trends shown here follow roughly the variations in the monthly normals of total precipitation except in September and October, when the heaviest rains are much above the usual ratio to the normal rainfall of the season.

Five-inch rains by stations.—The number of occurrences of 5 inches or more in 24 hours was determined for 52 stations for the 25-year period 1908–32. Only 6 of these had no 5-inch rains within this period; 21 had 3 or more such occurrences; and 6 had 6 or more.

Three-inch rains by stations.—The number of occurrences of 3 inches or more for the same 25-year period has been determined for 45 stations. The total number of such occurrences during these 25 years ranges from 10 at Gainesville to 47 at Marshallville. Only 15 of the stations had fewer than 20 such occurrences, and 19 had 25 or more.

There are two regions of noticeable frequency of such rains. The first extends across the middle of the State from around Columbus to beyond Macon; the second covers the southern part of the State northward as far as Blakely at the west and far beyond Brunswick on the coast, though falling short of Alapaha and Waycross.

These heavy rains have their least frequency below the mountain area in the northern section of the State, particularly from near Tallapoosa and Rome to about Hartwell and Augusta. A region of similar low frequency appears in the southeastern part of the State back of the coast counties.

One-inch rains.—The high frequency of rains of 1 inch or more in 24 hours prompted the writer to determine the number of days with such amounts and the percentage of total rainfall occurring in daily quantities of 1 inch or more. This investigation was limited to 26 representative stations and to the 20 years, 1911–30.

The average annual number of days with 1 inch or more shows little variation over the State, ranging from 12 to 16, except in the extreme northeastern section, where the Clayton record gives an annual average of 27. The greatest number of such days at Clayton for any single year was 39; and the greatest number for any month was 10, in July 1916.

The total number of days with 1 inch or more in the 20 years was greatest in July, ranging from 19 at Athens to 50 at Clayton and 51 at Waycross; and least in November, from 11 at St. George and Savannah to 22 at Rome.

Percentage of rainfall in amounts of 1 inch or more.—Before making this investigation the writer had the impression that not less than half of Georgia's total precipitation comes in amounts of an inch or more within 24 hours, and the facts ascertained gave substantial support to that original idea.

Beginning with the Atlanta record and using for convenience the daily amounts (midnight to midnight) there was found a total of 442.26 inches occurring in daily amounts of 1 inch or more during the 20 years, 1911–30. This is 46 percent of the entire precipitation for the period. Later the same 20-year period was examined and a compilation made of all rainfall of an inch or more falling within periods of 24 consecutive hours. Of course, a considerably larger amount was obtained than by the first method, the result being 521.10 inches, or 54 percent of the entire precipitation for the period.

To make the investigation fairly conclusive it was extended through the records of 25 stations well distributed over the State and covering the same 20-year period that had been used for Atlanta. On the basis of daily amounts as entered in the original records the percentages came out mostly in the upper forties, though ranging from 44 at Athens to 66 at Clayton.

Were it possible to determine accurately the greatest amount of rainfall for periods of 24 consecutive hours in each instance throughout these records, there is no doubt that the percentage of the total rainfall occurring in amounts of an inch or more would prove to be well above 50 for the State as a whole, as was found in the case of Atlanta.

The following table shows the most important results of the investigation for some of the better-known stations:

Precipitation in daily amounts of an inch or more in the 20-year period, 1911–30

Stations	Total number of days	Average annual amount	Percent of entire precipitation
Albany	319	26.65	51
Americus	307	25.19	51
Athens	263	21.40	44
Atlanta	274	22.11	46
Augusta	257	21.13	47
Bainbridge	295	25.56	50
Brunswick	289	26.11	52
Clayton	546	46.70	66
Columbus	261	22.56	46
Gainesville	314	24.56	45
Macon	246	21.71	47
Newnan	318	24.90	49
Rome	310	24.32	45
Savannah	258	22.45	48
Thomasville	305	26.57	51
Waycross	295	24.84	49

The percentage of total rainfall occurring in daily amounts of an inch or more is greatest in the northeastern mountain area, 66 at Clayton, from which it falls off to from 45 to 50 throughout the rest of the State, except across the southern portion, where it is slightly over 50.

One-inch rains by months.—The average amounts of rainfall occurring in quantities of an inch or more per day were determined by months for the 25 stations investigated, and it was found that the months of prominence generally are March and July. However, 5 stations had their monthly maximum in September, 2 in August, and 1 each in December and January.

Prolonged heavy rains.—One of the most interesting and important aspects of heavy rainfall in Georgia is the occasional occurrence of prolonged heavy rains for several days over extensive areas. When such a condition occurs, a rapid rise in the rivers is certain to follow, especially if the ground is fairly well saturated with moisture before the heavy rains begin. If at the same time the weather is cold enough to prevent much evaporation and vegetation is dormant or nearly so, the floods are still greater.

The following paragraphs indicate the intensity of the more important flood-producing rains in Georgia during the past 35 years and show the resulting rises in the rivers within the areas chiefly affected.

Heavy rains of March 22–24, 1908.—The rainfall at 15 stations, practically limited to a 2-day period, averaged 5.87 inches.

River	Total rise	Crest stage	Place	Days time
Savannah	20.1	29.6	Augusta	5
Oconee	21.1	25.8	Milledgeville	3
Chattahoochee	36.5	42.0	Eufaula	3
Do	28.6	36.5	Alaga	4

Heavy rains of March 13–16, 1913.—The rainfall at 10 stations in from 2 to 4 days averaged 7.09 inches.

River	Total rise	Crest stage	Place	Days' time	Rise in 1 day (feet)
Savannah	20.8	35.1	Augusta	3	11.5
Oconee	27.0	33.0	Milledgeville	5	11.6
Ocmulgee	23.2	27.0	Hawkinsville	6	
Flint	23.8	30.3	Albany	8	
Chattahoochee	32.5	54.5	Eufaula	4	14.7
Do	24.4	40.2	Alaga	5	12.8
Oostanaula	13.0	25.0	Resaca	4	
Coosa	16.6	25.0	Rome	3	

Heavy rains of July 7–11, 1916.—There was an average of 8.93 inches of rain in from 2 to 5 days (3 days in most cases) at 34 stations, just half the stations then in operation within the State. At Blakely 21.69 inches fell within 4 days; 6 other stations had over 10 inches each within 3 days.

River	Total rise	Crest stage	Place	Days' time	Rise in 1 day (feet)
Savannah	18.9	28.4	Augusta	3	
Ocmulgee	24.9	28.1	Hawkinsville	7	
Flint	20.4	22.3	Montezuma	5	
Do	24.0	25.0	Albany	4	10.7
Do	24.4	28.7	Bainbridge	5	10.5
Chattahoochee	48.6	52.4	Eufaula	4	38.8
Do	40.2	44.0	Alaga	2	29.0
Etowah	22.9	23.9	Canton	3	
Oostanaula	19.9	23.4	Resaca	3	11.0
Coosa	27.7	34.3	Rome	5	14.6

The rise of practically 39 feet cited here as occurring within 1 day at Eufaula on the Chattahoochee River is the most rapid rise ever known to have occurred at that station, and possibly it never has been exceeded anywhere in Georgia. The first 40 feet of the rise was produced by an average rainfall of about 5 inches over the drainage area above Eufaula, but during the entire period of heavy rain the average was about 9 inches and the total rise 48.6 feet.

Heavy rains of December 7–10, 1919.—The rainfall at 21 stations (mostly within 3 days) averaged 8.05 inches. Atlanta had 11.75 within 3 days. Rivers rose as indicated below. The river stage at West Point was the highest of record at that station.

River	Total rise	Crest stage	Place	Days' time	Rise in 1 day (feet)
Savannah	28.4	35.4	Augusta	4	19.5
Broad	25.3	28.0	Carlton	3	15.0
Oconee	26.9	31.4	Milledgeville	5	10.3
Do	24.0	24.0	Dublin	8	
Ocmulgee	23.3	25.3	Macon	4	10.4
Do	25.9	29.3	Hawkinsville	6	
Apalachicola	21.9	24.9	River Junction	8	
Flint	22.2	24.2	Albany	7	
Chattahoochie	49.6	52.4	Eufaula	4	17.7
Do	36.7	40.7	Alaga	5	18.5
Do	25.9	29.3	West Point	4	

Heavy rains of September 15–16, 1924.—The rainfall at 8 stations averaged 7.83 inches, with over 10 inches at 2 stations. Although there were sharp rises in several of the rivers, there was no flood owing to low initial stages and the dry condition of the ground immediately preceding the heavy rains. So much of the rain was absorbed by the soil that the percentage of run-off was much less than usual. The latter part of the month was wet, and another period of widespread heavy rain set in on the 24th. While the rains of the latter period were a little below the limits fixed for this discussion, the rivers rose rapidly under their influence owing to the wet condition of the soil and consequent higher percentage of run-off. The result was that flood stages were reached in many places before the close of the month.

Heavy rains of January 16–20, 1925.—The rainfall at 22 stations (limited to 3 or 4 days except at 1 station) averaged 8.07 inches. At 2 stations there was over 10 inches within 4 days. The rivers had already risen to fairly high stages as a result of heavy rainfall from the 10th to the 12th of the month. The additional rise brought the streams to the highest stages ever known at several stations and to the second highest at some others. Rivers rose as follows:

River	Total rise	Crest stage	Place	Days' time	Flood stage
Savannah	22.3	36.5	Augusta	4	32
Do	12.3	[1] 30.5	Charlotte	7	12
Oconee	23.6	36.7	Milledgeville	3	22
Do	9.4	[1] 29.8	Dublin	5	22
Ocmulgee	14.7	[1] 27.6	Macon	3	18
Do	10.9	[1] 36.5	Hawkinsville	2	29
Do	6.1	[1] 20.3	Abbeville	8	11
Do	11.9	[1] 26.3	Lumber City	5	15
Apalachicola	10.1	[2] 32.1	River Junction	9	20
Do	5.6	[2] 27.9	Blountstown	12	15
Flint	10.0	[1] 36.6	Albany	5	20
Do	13.7	[1] 40.9	Bainbridge	9	25
Chattahoochee	16.5	24.6	West Point	3	19
Do	37.8	[2] 59.8	Eufaula	4	40
Do	16.2	[2] 44.5	Alaga	5	32

[1] Highest stage on record for the station.
[2] Second highest stage on record for the station.

Heavy rains of August 13–16, 1928.—The rainfall at 8 stations averaged 6.76 inches, following heavy rains in central and southwestern Georgia on the 10th and 11th. The Oconee River at Milledgeville rose to 38.7 feet on the 16th, the highest on record at that station.

Heavy rains of March 14–16, 1929.—The 2-day rainfall at 12 stations averaged 7.46 inches. More than 11 inches fell at 2 different stations within 2 days. The effect of these rains was heightened by two periods of extraordinary rainfall closely preceding. The first of these came on February 27–28 with an average of 6.09 inches for 2 days at 13 stations. The second came on March 4–5 with an average of 5.87 inches for 2 days at 13 stations.

A remarkable series of floods resulted in some places. For example, at Milledgeville the Oconee River reached 35.7 feet (13.7 feet above flood stage) on February 28; it fell to 19.5 on March 4 and rose to 34.7 the next day; then it fell to 9.2 on the 13th and rose to 29.6 on the 16th.

Some portions of the lower Chattahoochee and lower Flint were above flood stages the greater part of March 1929. The Apalachicola was above the flood stage (20 feet as then designated) at Blountstown, Fla., from February 25 to April 3, and above flood stage at River Junction, Fla., from March 1 to 30. The Altamaha at Everett City was above flood stage from February 22 to April 11, and reached the highest stage on record at that station (16 feet) on March 15.

Some of the more remarkable river rises during the latter part of March were as listed below.

River	Total rise	Crest stage	Place	Days' time
Oconee	20.0	29.6	Milledgeville	2
Ocmulgee	14.3	24.7	Macon	2
Do	13.9	32.7	Hawkinsville	4
Flint	15.6	[1] 27.4	Montezuma	3
Do	9.2	[2] 34.4	Albany	6
Chattahoochee	19.7	[2] 26.0	West Point	3
Do	48.6	[1] 63.8	Eufaula	4
Do	26.4	[1] 46.0	Alaga	5
Apalachicola	10.8	[1] 35.0	River Junction	5
Do	5.5	[1] 28.6	Blountstown	6

[1] Highest stage on record for the station.
[2] Second highest stage on record for the station.

Heavy rains of September 25–27, and October 1–2, 1929.—In the first of these periods the rainfall at 19 stations (chiefly limited to 2 days) averaged 9.65 inches. The outstanding instances of heavy rain were:

14.48 inches in 2 days at Double Branches.
14.49 inches in 2 days at Washington.
19.31 inches in 3 days at Brooklet.
10.90 inches in 3 days at Millen.
19.45 inches in 3 days at Glenville.

In the second of these periods the rainfall within 2 days at 23 stations averaged 6.82 inches.

At many places along the rivers there was little or no fall before the second heavy precipitation was draining into the streams. In the following table the rise was computed from the lowest stage immediately preceding the first period of heavy rain except when a greater rise was produced by the second period of rains alone.

River	Total rise	Crest stage	Place	Days' time
Savannah	38.0	45.1	Augusta	7
Oconee	30.3	36.9	Milledgeville	7
Do	25.4	27.6	Dublin	9
Ocmulgee	17.6	24.9	Macon	2
Do	23.5	30.5	Hawkinsville	10
Flint	22.3	25.3	Albany	9
Chattahoochee	42.8	47.0	Eufaula	8
Do	33.1	39.1	Alaga	8

TYPES OF HEAVY-RAIN-PRODUCING STORMS IN GEORGIA

By ARTHUR H. SCOTT

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In any study of the heavy rainfall in Georgia, it is interesting to consider the conditions that cause them and the type of associated storm movement. Georgia, because of its proximity to the Atlantic Ocean and the Gulf of Mexico, has abundant moisture close at hand, and when conditions are present that will cause condensation over the State, it is possible that excessive rains may result. The Blue Ridge Mountains, moreover, covering much of the northern part of the State, and facing the moisture-bearing winds from the Atlantic Ocean, induce abundant precipitation along their eastern slopes. Georgia, furthermore, lies within or near the track of many cyclonic storms. It is well, therefore, to determine what types of storm movement cause heavy rainfall in this State.

Prof. Alfred J. Henry in his article on The Distribution of Excessive Precipitation in the United States in the MONTHLY WEATHER REVIEW, September 1928, vol. 56, page 863, says:

> Finally, the outstanding result of this study is the fact that the atmosphere over the United States, say east of the one hundredth meridian, contains during the warm season a high-water content which awaits only suitable temperature relations in order to produce excessive rains for a short period of time.
>
> The longer excessive rains (24 hours) are due, as a rule, to any of the following conditions: The advent of a tropical cyclone along the Gulf or eastern seaboard; the seemingly fortuitous relatived geographical position with reference to each other of a vigorous extratropical cyclone with a strong anticyclone immediately to the northeast; the same condition, although in a slightly different form, viz, the intrusion of an anticyclone (cold front) into an extensive barometric trough wherein high temperature and vapor content prevail also causes excessive rains for 24 hours and sometimes longer.

As applied to Georgia, these conclusions just quoted hold very well. Georgia occasionally is visited by tropical storms which cause heavy rains over areas far beyond the extent of destructive winds, sometimes even to the northern section of the State. As a rule, the heaviest rainfall occurs east of the track of the center of the storm, especially when it has recurved and is moving northward or northeastward, as in the storms of August 10–11 and 14–15, 1928, September 17–18, 1928; and the storm of July 7–9, 1916, which caused widespread excessive rains. In this connection, it is well to note that occasionally a tropical storm drifting slowly over the State, as in July 1916, leaves the atmosphere so humid and the ground so wet that showers are frequent for several days after the barometric depression has filled up. Naturally, the heavy rainfalls attending tropical storms are limited to the hurricane season, that is, from late June into October, with the greatest frequency in August and September.

Apart from the tropical disturbance, the main rainfall producer during the summer months in Georgia is the thunderstorm. Convective action is at its height during the warm season and the cyclonic movement weak. The Atlantic high pressure area in the vicinity of Bermuda seems to be the dominating factor in the weather control of Georgia, especially during the warm months, for when it shifts to the westward dry weather prevails over much of the eastern portions of the country; but when its western edge is off the Carolinas while a shallow barometric trough extends from the St. Lawrence Valley southwestward over the Ohio and lower Mississippi Valleys, or if the pressure gradient is weak to the west of the high pressure area, with the morning temperatures well up, say to 70° or over, heavy thundershowers are likely to occur locally in Georgia. When a high pressure area west of the barometric trough advances with cooler weather, general thundershowers, often heavy, occur in most cases along the cool front. Similarly, if a high pressure area moving southward over the Atlantic States drifts over Georgia against a shallow trough of low pressure, torrential rains sometimes follow with the cooling of the warm, humid air. A movement of this kind caused particularly heavy rains in southeastern Georgia on September 9–10, 1908.

The occurrence of excessive precipitation is more or less confined to local areas except in the cases of tropical cyclones.[1] The thunderstorm, being the result often of purely local convective action, affects only a limited area, and we have therefore at times single, isolated heavy downpours and at others a series of locally heavy showers. Anything that induces strong vertical convection of

[1] Henry, Alfred J., The Distribution of Excessive Precipitation in the United States. MONTHLY WEATHER REVIEW, September 1928, vol. 56, p. 357.